

Remarks

Examiner Im is thanked for the thorough Office Action.

In the Drawings

Applicants again acknowledge the acceptance of the drawings filed on 11 May 2006, i.e. sheet 3/7, Fig. 6.

In the Claims

Claims 36 to 38 have each been amended to delete limitation b) (and to delete "a)" at line 2 and "c)" at line 5). Applicant's attorney reserves the right to reinstate these deleted limitations at a later time without prejudice.

Claim Rejections

The Rejection Of Claims 1 To 10, 13 To 21, 24 To 33 And 36 To 38 Under 35 U.S.C. §103(a) as Being Unpatentable Over Alvarez (U.S. Patent No. 6,732,913) In View Of Hikita et al. (U.S. Patent No. 6,965,166)

The rejection of claims 1 to 10, 13 to 21, 24 to 33 and 36 to 38 under 35 U.S.C. §103(a) as being unpatentable over Alvarez (U.S. Patent No. 6,732,913) (the '913 Alvarez Patent) in view of Hikita et al. (U.S. Patent No. 6,965,166) (the '166 Hikita Patent) is acknowledged.

The Rejection Of Claims 12, 23 And 35 Under 35 U.S.C. §103(a) as Being Unpatentable Over Alvarez (U.S. Patent No. 6,732,913) In View of Hikita et al. (U.S. Patent No. 6,965,166) As Applied To Claims 1, 13 And 25 Above, And Further In View Of Yanagida et al. (U.S. Patent No. 6,204,558)

The rejection of claims 12, 23 and 35 under 35 U.S.C. §103(a) as being unpatentable over Alvarez (U.S. Patent No. 6,732,913) (the '913 Alvarez Patent) in view of Hikita et al. (U.S. Patent No. 6,965,166) (the '166 Hikita Patent) as applied to claims 1, 13 and 25 above, and further in view of Yanagida et al. (U.S. Patent No. 6,204,558) (the '558 Yanagida Patent) is acknowledged.

The Rejection Of Claims 11, 22 And 34 Under 35 U.S.C. §103(a) as Being Unpatentable Over Alvarez (U.S. Patent No. 6,732,913) In View of Hikita et al. (U.S. Patent No. 6,965,166) As Applied To Claims 1, 13 And 25 Above, And Further In View Of Degani et al. (U.S. Patent No. 6,734,539)

The rejection of claims 11, 22 and 34 under 35 U.S.C. §103(a) as being unpatentable over Alvarez (U.S. Patent No. 6,732,913) (the '913 Alvarez Patent) in view of Hikita et al. (U.S. Patent No. 6,965,166) (the '166 Hikita Patent) as applied to claims 1, 13 and 25 above, and further in view of Degani et al. (U.S. Patent No. 6,734,539) (the '539 Degani Patent) is acknowledged.

The claims are rejected under § 103(a) over the '913 Alvarez Patent and the '166 Hikita Patent (and further in view of the '558 Yanagida Patent as to claims 12, 23 and 35) (and further in view of the '539 Degani Patent as to claims 11, 22 and 34).

Section 2142 of the MPEP

According to Section 2142 of the MPEP, "The examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. ... To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure."

Brief Summary of Instant Invention

Applicant's attorney wishes to briefly point up the claimed features of their invention which are believed to be not shown nor obvious from the teachings of known references in this field. Using independent claim 1 as an example (with the alternate additional limitations from independent claims 13 and 25 shown in *italics*) claims all clearly define a die comprising:

a single substrate;

two or more various shaped bump structures formed over the single substrate; each of the two or more various shaped bump structures having a solder line; [*CLAIM 13: one or more of the two or more various shaped bump structures having a first height and one or more of the two or more various shaped bump structures having a second height that is less than the first height;*] / [*CLAIM 25: the two or more various shaped bump structures having a round shape, a rectangular shape, a square shape, a bar shape or a circular shape;*] and

an epoxy layer formed over the single substrate; the epoxy layer having a top surface.

The '913 Alvarez Patent

The '913 Alvarez Patent discloses a method for fabricating a chip scale package using wafer level processes to obtain a chip level package by avoiding the use

of mechanical grinding by the use of molding, extruding and etching technologies. For example, die pads 212 are formed over a semiconductor wafer 205. Copper pillars (conductors) 210 topped with gold (a conductive etch resistant material) 405 are formed over the die pads 212 (FIG. 4B) and then, using a extrusion, spin coating or molding process, a fluid layer of coating 410 (e.g. Dexter's underfill epoxy) is formed and the layer of coating 410 is applied over the semiconductor wafer (FIG. 4C) and cured by heating.

The gold topped copper pillars 210/405 protrude away from the layer of coating material 410 with portions 505 of the cured coating layer 410 adhering to the top of the upper surface 510 of the gold layer 405 and portions 515 of the cured coating material 410 adhering to the side surfaces 520 of the copper pillars 210 (FIG. 5).

Then, etchant is applied to the coated surface of the semiconductor wafer 205 to etch 330 away the portions 505 and 515 of the cured layer of coating material 410 on the gold layers 405 and on the side surfaces 505 of the copper pillars 210 (FIGS. 4D and 6).

Solder balls 415 are then attached to the copper pillars 210 and reflowed 345 (FIG.4E).

The '166 Hikita Patent discloses using metal balls 14 on a second semiconductor chip *1b* as registration projections (Col. 4, lines 63 and 64) to engage onto corresponding (depressed) pads 12 spaced apart on a first semiconductor chip *1a* so that, for example, respective pairs of opposing (squarish as shown in Fig. 1, for example) bumps 3 formed on the first and second chips *1a*, *1b* may properly engage.

Summary of Examiner's Rejections of Independent Claims 1, 13 and 25 Under §103(a)

The Examiner states that Alvarez does not disclose (or fairly teach):

CLAIM 1: "two or more various shaped bump structures";

CLAIM 13: "two or more various shaped structures having a first height and one or more of the two or more various shaped bump structures having a second height that is less than the first height" (sic); or

CLAIM 25: "the two or more various shaped bump structures having a round shape, a rectangular shape, a square shape, a bar shape or a circular shape" (sic).

The Examiner then attempts to combine Hikita with Alvarez under §103(a) to meet the limitations of the pending claims.

ARGUMENT - Independent Claims 1, 13 and 25

Applicant's attorney urges that the Examiner's combination of the '913 Alvarez Patent with the '166 Hikita Patent under §103(a) is improper for each of the independent claims 1, 13 and 25, and thus for all pending claims as the remaining claims depend from one of these three independent claims for, inter alia, the following reasons.

As summarized above, Alvarez teaches a method to avoid the use of mechanical grinding to form a chip level package by forming a fluid layer of coating 410 over protruding gold capped copper pillars 210, curing the layer of coating 410 and then employing an etchant to remove portions 505, 515 of the cured layer of coating 410 adhering to: the gold's top surface 510; and the copper pillars' side surfaces 505, respectively. Applicant's attorney urges that this etching away of the portions 505, 515 of cured layer of coating 410 could not be properly performed by one skilled in the art from the disclosure and teachings of Alvarez, if the "various shaped bump structures" 14, 3 of Hikita were incorporated into the device of Alvarez as suggested by the Examiner.

Applicant's attorney urges that if the different shapes of Hikita were incorporated into Alvarez, then the process of Alvarez would not properly work to achieve the end results / structure disclosed by Alvarez. The layer of coating 410 would not adhere consistently (even thicknesses on corresponding surfaces) to bump structures having:

various shapes (instant Claim 1);

various shapes having at least two differing heights (instant Claim 13); or

various shapes having a round shape, a rectangular shape, a square shape, a bar shape or a circular shape (instant Claim 25);
either on their top surfaces or their side surfaces.

Applicant's attorney urges such a consistency of thickness of the layer of coating 410 is required in Alvarez to achieve its stated and disclosed purpose / structure of (forming) a chip level package. For example, inter alia, the Alvarez side surfaces 520 must also be etched free of the cured layer of coating 410 as Alvarez states at Col. 2, lines 36 to 41, referencing the disadvantages of the stated prior art "Since only the upper surfaces of the layer of gold are exposed, the surface area of the gold layer to which the solder balls 230 can adhere is limited. Hence, another disadvantage is the limited surface area of the layer of gold to which the solder balls can adhere, as this can adversely affect the reliability of the WL-CSP."

Having "two or more various shaped bump structures" as claimed in the instant invention, and for which the Examiner cites Hikita to combine with Alvarez under 103(a), would render Alvarez effectively inoperative and thus Alvarez teaches away from the instantly claimed invention. The combination of Hikita with Alvarez is improper and all pending claims 1 to 38 distinguish over Alvarez in view of Hikita under §103(a) for all the Examiner specific rejections for the above reasoning and further because, inter alia: the prior art lack a suggestion that Alvarez should be modified in the manner suggested by the Examiner as required to meet the claims; the Examiner has made a strained interpretation of the cited references that could be made only be hindsight; the Examiner has not presented a convincing line of reasoning as to why the claimed subject matter as a whole, including its differences over the prior art, would have been obvious; and the prior art references do not contain any suggestions

(express or implied) that they be combined, or that they be combined in the manner suggested.

ARGUMENT - Amended Dependent Claims 36 to 38

Further, for example, amended dependent claims 36 to 38 (which depend from respective independent claim 1, 13 and 25) each adds the further limitations of “wherein the solder lines are below the top surface of the epoxy layer; or some of the solder lines are below the top surface of the epoxy layer and some of the solder lines are above the top surface of the epoxy layer.”

However, Alvarez is explicit in that the level of the etched layer of coating 410 (FIG. 4D) is below the solder lines as, at Col. 6, lines 12 to 16, the etchant etches “away the portions 505 and 515 of the cured layer of coating material 410 on the gold layers 405 and on the side surfaces 505 of the copper pillars 210. FIG. 4D shows the semiconductor wafer 205 after etching,...”. And, at Col. 6, lines 46 to 49 “[t]he present invention, as described, advantageously allows solder to adhere to the layer of gold and the side surfaces of the copper pillar resulting in a stronger mechanical joint and a more reliable electrical connection.” Since, the solder balls 415 are attached to the copper pillars 210 after etching of the cured layer of coating material 410, the etched coating material 410 could not be above the solder lines of Alvarez and thus amended claims 36 to 38 are non-obvious over Alvarez in view of Hikita under 35 U.S.C. §103(a).

Claims 2 to 12 and 36 depend from independent claim 1; claims 14 to 24 and 37 depend from independent claim 13; and claims 26 to 35 and 38 depend from independent claim 25 and are believed to distinguish over the combination for the reasons previously cited.

Therefore claims 1 to 38 are submitted to be allowable over the cited references and reconsideration and allowance are respectfully solicited.

CONCLUSION

In conclusion, reconsideration and withdrawal of the rejections are respectively requested. Allowance of all claims is requested. Issuance of the application is requested.

It is requested that the Examiner telephone Stephen G. Stanton, Esq. (#35,690) at (610) 296 - 5194 or the undersigned attorney at (845) 452 - 5863 if the Examiner has any questions or issues that may be resolved to expedite prosecution and place this Application in condition for Allowance.

Respectively submitted,

A handwritten signature in black ink, appearing to read 'SBA', is written over a horizontal line.

Stephen B. Ackerman
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